Chapter 2

Non-Medical Nuclear, Biological, and Chemical (NBC) Defense Requirements and Research, and Acquisition Program Status

2.1 INTRODUCTION

This chapter describes the consolidation of Joint Service non-medical NBC defense requirements and assesses how these programs meet the needs of U.S. forces. The discussion of requirements and the status of research and development assessments is conducted within the framework of the three principles of NBC defense doctrine for the mission area:

- Contamination avoidance
- Protection
- Decontamination

As defined in Joint Pub 3-11, *Joint Doctrine for Nuclear, Biological, and Chemical Defense,* contamination avoidance includes detecting, avoiding, and bypassing contaminated areas. Protection consists of individual and collective protection. Decontamination restores combat power and is essential for sustaining operations in a contaminated environment. Medical programs support these areas and are discussed in Chapter 3.

The threat from the continued proliferation of NBC weapons—as described in the Introduction—creates a continuous need to ensure that U.S. forces can survive, fight, and win in an NBC threat environment. The increasing danger from these weapons demands that we look for every opportunity to avoid technological surprises. Evolving operational requirements demand that the joint program progressively capture and leverage advances in technology to provide the best in NBC defense equipment for the forces.

Our research, development, and acquisition (RDA) goal is to equip the force with sufficient quantities of world-class equipment and in the shortest time possible in order to win decisively, quickly, and with minimal casualties. As authorized under the Joint Service Agreement for non-medical programs and in cooperation with the Armed Services Biomedical Research, Evaluation and Management (ASBREM) Committee for medical programs, the Army as executive agent coordinates, integrates, and reviews the DoD CB Defense Program. The results of these reviews, conducted with all Services participating, are documented in the Joint Service Modernization and Joint Service RDA Plans. These documents form the basis for the consolidated CB Defense Program Objectives Memorandum (POM).

The Services in coordination with the Commanders-in-Chief (CINCs) decide if a material solution is needed to satisfy a requirement for a war fighting capability. They first look at doctrinal, training, or organizational solutions (non-material solutions), and when these cannot be found, they seek equipment solutions through the materiel acquisition cycle. If a valid need exists, then the research and development modernization process will identify technological approaches which may provide a new system or upgrade an existing system.

During FY98 the Joint Service Integration Group documented the Joint Future Operational Capabilities (JFOC). The purpose of the JFOC is to identify and prioritize Joint User (Services and CINCs) far-term future operational capabilities as expressed in the emerging Joint NBC Defense Concept. The overall intent is to provide enhanced user guidance to the Joint NBC Defense Science and Technology (S&T) community to assist in the NBC S&T program formulation and program execution process. The JFOC will also support the development of new NBC Defense Joint Mission Needs Statements (JMNSs) and future Joint Operational Requirement Documents (JORDs). The prioritized list of JFOCs establishes a clear link between near and long term Joint NBC Defense research and development efforts and user needs. Table 2-1 provides a synopsis of the current JFOC priorities, descriptions, and objectives. The JFOC has become an integral part of the Joint Service NBC Defense Modernization Plan and related science and technology plans, including the Joint Warfighting Science and Technology Plan (JWSTP) and the Defense Technology Area Plan (DTAP).

Table 2-1. Prioritized Joint Future Operational Capabilities

1: Contamination Avoidance — An enhanced capability to detect, locate, identify, and confirm the presence or absence of any standard or non-standard NBC hazard. Significantly improve tactical, operational, and strategic NBC situational awareness by rapidly detecting, locating, identifying, confirming and disseminating NBC and toxic industrial material (TIM) detection information to the joint force.
2: NBC Battle Management — Capability to access, assimilate and disseminate NBC information from throughout the battlespace via standard, joint service and automatic information/data transmission systems. Enhance warfighter protection by providing the critical link between detection and protection. Commanders at all levels will be provided sufficient, timely information through early and direct warning. Commanders will be able to quickly and effectively quantify the risk associated with various courses of action and provide real-time display with local 3-D digital terrain graphics to portray the current status of the NBC battlespace.
3: Collective Protection — To protect the joint force by allowing it to operate safely, at near-normal levels of effectiveness, while under NBC threat, or in NBC, TIM or other environmental hazards area. Enhance filter systems on existing vehicles, aircraft, shipboard, communications vans and other static/mobile structures.
4: Restoration Capability — Enhanced capability to provide rapid, effective, and safe removal/neutralization of hazards resulting from NBC or TIM contamination to enable restoration of unit operational capabilities. Protect and sustain the Joint force by rapidly returning equipment and personnel to normal operating modes/efficiencies after exposure to an NBC or TIM contaminated environment.
5: Individual Protection — To protect the joint force by allowing it to operate safely, at near-normal levels of effectiveness, while under NBC threat, or in NBC, TIM or other environmental hazards area.

In accordance with our national strategy of achieving and applying technological superiority, several underlying concepts form the foundation of acquisition modernization. The first is the need to reduce cycle time in the acquisition of new systems or the integration of emerging technologies into existing systems. The use of Advanced Concept Technology Demonstrations (ACTDs), open systems and architectures, along with the new emphasis on commercial standards and practices, allow us to shorten the acquisition cycle time. The program acquisition process reduces lifecycle costs through practices such as design-to-cost and concurrent engineering to ensure that equipment is easy to maintain and repair even with the inherent complexity in most new systems.

2.2 NBC DEFENSE MISSION AREA REQUIREMENTS AND RDA SUMMARY

NBC defense programs are categorized broadly under three operationally oriented areas: contamination avoidance, protection, and decontamination. The Services have been working

closely together to increase jointness in ongoing programs for each of these areas. This report highlights improvements during FY98 and discusses cooperative efforts for further Joint development of requirements. This section summarizes the requirements in each of the mission commodity areas. Tables 2-2 through 2-10 display requirements and acquisition strategies. Since the focus of this chapter is on research and development efforts, fielded items are not included in these tables. Descriptions of developmental and fielded equipment can be found in Annexes A–C of this report.

2.3 CONTAMINATION AVOIDANCE (Detection, Identification and Warning)

The operational concept of contamination avoidance includes NBC reconnaissance, detection, identification, warning and reporting. Earliest possible warning is the key to avoiding NBC contamination. For fixed sites where contamination cannot readily be avoided and for missions requiring operations in a contaminated environment, detection, identification, and warning are equally critical to ensure that forces can (1) assume the optimal protective posture so that they can continue to sustain operations and (2) rapidly identify and decontaminate affected areas, equipment, and personnel. Sensors for the individual warfighter and systems capable of detecting multiple agents and characterizing new agents are being developed. Advances in technology are being pursued in chemical and biological standoff, early warning detection, miniaturization, interconnectivity, improved detection sensitivity, improved logistics supportability, and affordability. The following sections detail contamination avoidance science and technology efforts, modernization strategy, and Joint Service programs.

2.3.1 Contamination Avoidance Science and Technology Efforts

2.3.1.1 Goals and Timeframes. The goal of contamination avoidance is to provide real-time capability to detect, identify, characterize, locate, and warn against all CB warfare agent threats below threshold effects levels (see Table 2-2). To meet near term needs a number of sensor technologies are being optimized while alternative detection technologies mature. Mid-term technologies focus on developments to improve tactical detection and identification capabilities for both chemical and biological warfare agents. Far-term science and technology efforts focus on multi-agent sensors for biological agent detection and remote/early warning CB detection. These far-term objective technologies seek to integrate chemical and biological point and remote/early warning detection modules into a single system. Research and Development (R&D) efforts seek to optimize and balance system sensitivity, size/weight, cost, power consumption, signature and false alarm rate. Ultimately the goal is direct integration of CB detectors as a single system into various platforms, and command, control, communication, computer, and intelligence (C^4I) networks.

Table 2-2. Contamination Avoidance Science and Technology Strategy

By 1999	By 2005	By 2009
• Complete installation of the Portal Shield ACTD biological and chemical detection network at CINC air bases and ports • Complete demonstration of integrated point biodetection capability (Advanced Technology Demonstration)	• Field upgrade (eye safe) Long Range Bio Stand-off Detector in FY00-02. • Joint Biological Remote Early Warning System (JBREWS) ACTD with fielding of ACTD systems to selected CINCs by FY01 • Complete development of Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD) • Initiate development of Joint Service Warning and Identification LIDAR Detection (JSWILD) • Complete development of Joint Chemical Agent Detector (JCAD) • Complete development of Block II Joint Biological Point Detection System (JBPDS)	• Demonstrate integration of chemical and biological agent detection modules into a single sensor suite • Initiate development of hand-held equipment chemical contamination scanner • Complete development of CB water monitor • Complete development of JSWILD

2.3.1.2 <u>Potential Payoffs and Transition Opportunities</u>. Future CB detection systems will provide the capability to detect, identify in real time, map, and track all CB contamination in a theater of operations. This will enable commanders to avoid CB contamination or to assume the appropriate protection required to continue fighting and sustain their mission with minimal performance degradation and casualties. The program seeks to develop small, lightweight chemical detectors to provide an individual chemical detection capability. CB detection technologies have dual use potential in monitoring air pollution, noxious fumes inside enclosed areas, and municipal water supplies.

2.3.1.3 <u>Major Technical Challenges</u>. The major technical challenges are in the areas of biological collection, detection and identification, including remote/early warning sensing, improved agent discrimination and quantification, sample processing, interferent and ambient biological background rejection, and genetic probe development. Size, weight, and power reduction of detectors, power generation and consumption, development of integrated biological and chemical detection systems, and the fusion of sensor data with mapping, imagery, and other data for near real-time display of events are other areas of challenge.

There are two critical needs, both are focused on biological agent detection. Current technologies require a *high level of logistical support* and *lack discrimination in biological standoff detection*. The challenge in reducing logistical support stems from the dependence on reagents and size, weight, and power requirements of the systems. Several efforts address these issues and can be broken out as efforts in minimizing reagent requirements with higher sensitivity, better stability, and fewer supporting reagents, and scientific/engineering strategies to reduce size, weight, and power requirements, especially in the sample collections components. There are several factors directly limiting the ability to discriminate biological agents using standoff (laser) detection technologies. Key factors include: (1) a lack of fundamental data in understanding the spectral properties of biological warfare agents, (2) range limitations of lasers due to atmospheric absorption, and (3) natural background interference. Over the last two years, a number of strategies and concepts have been developed to improve the discrimination capability of standoff detection for biological materials. Preliminary data developed this past year has shown the potential feasibility of two of these concepts. Further efforts in FY02 and FY03 will

begin to validate the feasibility of providing an enhanced level of discrimination of biological material using standoff detection.

2.3.2 Contamination Avoidance Modernization Strategy

The increased lethality and heightened operational tempo of the future battlefield demand responsive NBC detection and warning capabilities in order to reduce force degradation caused by contamination. These capabilities—which also encompass NBC reconnaissance, detection, identification, and reporting—are critical for force readiness and will continue to be emphasized by the DoD community in the near and distant future. Table 2-3 shows the roadmap of DoD requirements for contamination avoidance.

Table 2-3. Contamination Avoidance Modernization Strategy

	NEAR (FY99-00)	MID (FY 01-05)	FAR (FY 06-15)
Chemical Point Detection	• **Surface sampling capability (ICAM)** • **Automatic point detection of nerve and blister agents (ACADA)** • Navy-*Ship based improved automatic point detection of nerve/mustard (IPDS)* • Navy-*Automatically detect liquid agent (SALAD)*	• **Improved, all-agent programmable automatic point detection; portable monitor, miniature detectors for aircraft interiors; interior ship spaces; individual soldiers (JCAD)**	• **Improved surface contamination monitor** • **Low dosage miniature detector; specific identification; personal monitor** • **Detection of CB contamination in water (Joint Chemical Biological Agent Water Monitor)**
Biological Point Detection	• **Automatic long line source and point/mobile biodetection to detect and identify bio-agents; programmable (JBPDS Block I)** • Navy-*Ship based Interim Biological Agent Detector (IBAD)* • Army-*Biological Integrated Detection System (BIDS)*	• **Automatic point biodetection, to detect and identify; programmable (JBPDS Block II)** • **Joint Biological Remote Early Warning System (JBREWS) - A distributed network of fully automated lightweight sensors.**	• **Automated detection of all validated biological threat agents (Joint Biological Universal Detector, JBUD)** • **Automated, integrated detection of both biological and chemical agents in a single sensor package (Joint Chemical and Biological Universal Detector, JCBUD)**
NBC Reconnaissance and CB Remote and Stand-off Detection	• **Improved NBC Reconnaissance Vehicle with remote/early warning and data infusion capabilities (JSNBCRS)** • Army - *Long Range Stand-off detection and mapping of aerosol clouds (LR-BSDS)*	• **Biological remote detection and early warning capabilities (JBREWS)** • **Lightweight passive stand-off detection for chemical agent vapors (JSLSCAD)** • **Addition of biological detection and identification capabilities (JSNBCRS P3I)** • **Light reconnaissance vehicle (JSLNBCRS)**	• **Stand-off detection, ranging, and mapping of chemical vapors and aerosols (JSWILD)** • **Wide area detection** • **Automated standoff detection of biological agents (JBSDS)**
Warning and Reporting	• **Automated warning and reporting (JWARN Phase I)**	• **Automatic NBC warning and reporting interoperable with all Services (JWARN Phase II)**	• **Integrated and automatic warning and reporting (JWARN Phase III)**
Radiation Detection	• Army-*Compact, digital whole body radiation measurement (AN/VDR-13)*		• **Stand-off radiation detection and measurement** • **Portable radiation meter**

1. Joint Service programs are highlighted in **BOLD**; Service unique efforts are *italicized.*
2. Where applicable, systems which meet requirements are listed following the entry.

Early detection and warning is the key to avoiding NBC contamination. As a result, DoD is concentrating RDA efforts on providing its warfighters real-time capabilities to detect, identify, quantify, and warn against all CB warfare threats below threshold effects levels. Real

time detection of biological agents below threshold effects levels is unlikely in the near to mid-term. Current emphasis is on developing lightweight, automated CB sensors capable of providing enhanced detection and early warning, capable of detecting all known biological and chemical agents. To meet the needs in the near to mid term, several stand-alone detectors and sensors are being developed. Developmental efforts are focusing on system miniaturization, improved sensitivity and specificity, agent characterization and range, decreased false alarm rate, and decreased operation and support costs. This focus will facilitate the integration of chemical detectors into personal warfighter gear, chemical and biological detectors onto various air, sea, and ground platforms, and integration of detectors into automated warning and reporting networks. Table 2-4 provides an overview of RDA efforts and Service involvement.

Table 2-4. Contamination Avoidance RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
Automatic Detectors and Monitors	- M22 Automatic Chem Agent Detection Alarm (ACADA)	Production	Joint	Joint	Joint	Rqmt
	- Shipboard Automatic Liquid Agent Detector (SALAD)	LRIP				Rqmt
	- Improved Point Detection System (IPDS)	Production				Rqmt
	- Improved CAM (ICAM)	Production	Rqmt	Interest	Rqmt	Interest
	- Joint Chemical Biological Agent Water Monitor (JCBAWM)	RDTE	Joint*	Joint*	Joint*	Interest
	- Joint Chemical Agent Detector (JCAD)	RDTE	Joint*	Joint*	Joint*	Joint*
	- Biological Point Detection					
	--Interim Biological Agent Detector (IBAD)	Fielded				*Rqmt*
	--Biological Integrated Detection System (BIDS NDI)	Fielded	*Rqmt*			
	--BIDS P3I	Production	*Rqmt*			
	- Portal Shield	Production	Joint	Joint	Joint	Joint
	- Joint Bio Point Detection System (JBPDS)	RDTE	Joint	Joint	Joint	Joint
Remote/ Early Warning	- Joint Service Lightweight Stand-off Chemical Agent Detector (JSLSCAD)	RDTE	Joint	Joint	Joint	Joint
	- Joint Service Warning and Identification LIDAR Detector (JSWILD)	RDTE	Interest	Interest		
	- Biological Stand-off					
	--Joint Remote Biological Early Warning System (JBREWS)	RDTE	Joint	Joint	Joint	Joint
	--Long Range Bio Stand-off Detection System-NDI (LRBSDS-NDI)	Fielded	*Rqmt*	*Interest*		*Interest*
	--LRBSDS	RDTE	*Rqmt*	*Interest*		*Interest*
NBC Recon	- Joint Service NBC Reconnaissance System (JSNBCRS)	RDTE				
	--M93A1 NBCRS/CB Mass spectrometer (See BIDS)	*	*Rqmt*		*Rqmt*	
	--Joint Service Light NBCRS/Lightweight Recon System (JSLNBCRS)	*	Joint*	Joint*	Joint*	*Interest*
Warning and Reporting	- Joint Warning and Reporting Network (JWARN)	RDTE/Prod	Joint*	Joint*	Joint*	Joint*
	-- Multipurpose Integrated Chemical Agent Detector (MICAD)	*	*Rqmt*		*Rqmt*	
Radiation Detection	- AN/UDR-13 Pocket Radiac	Production	Joint	Interest	Joint	

Joint= Joint Service requirement Joint*=Draft Joint Service requirement
Rqmt= Service requirement Int-NIR= Service interest, no imminent requirement
Rqmt, Interest= sub-product requirement or interest *= Sub-product(s) of a Joint project
LRIP= Low Rate Initial Production

The management challenge involves the coordination and consolidation of dozens of detection and warning RDA efforts across the Services. This strategy, led by the JSMG through the Contamination Avoidance Commodity Area Manager, resulted in the initiation of RDA efforts which shared common technical goals, but were constrained to Service unique requirements. Management organizations and initiatives, such as the Joint Program Office for Biological Defense (JPO-BD) and the Joint NBC Defense Board are building Joint Service coordination across the mission area.

Over the past several years, the JSMG and JSIG, through the Contamination Avoidance Commodity Area Manager, with assistance from JPO-BD transformed and consolidated 44 separate contamination avoidance developmental efforts into nine fully coordinated joint projects. The Joint Programs are:

- Automatic Chemical Agent Detection Alarm (ACADA)
- Joint Chemical Agent Detector (JCAD)
- Joint Service Lightweight Standoff Chemical Agent Detector (JSLSCAD)
- Joint Service Warning and Identification LIDAR Detector (JSWILD)
- Joint Biological Point Detection System (JBPDS)
- Joint Biological Remote Early Warning System (JBREWS)
- Joint Service Light NBC Reconnaissance System (JSLNBCRS)
- Joint Warning and Reporting Network (JWARN)
- Joint Chemical Biological Agent Water Monitor (JCBAWM)

2.3.3 Joint Service Contamination Avoidance Programs

The consolidation of Joint Service contamination avoidance programs has been completed. All detection programs have been restructured to meet current multi-Service needs. Bolded entries in Table 2-3 highlight Joint programs. Detailed descriptions of Joint contamination avoidance programs are provided in Annex A.

Chemical Warfare Agent Contamination Avoidance. An ACADA non-developmental item (NDI) is being procured for point detection of chemical agent vapors. ACADA is suitable for many vehicle-mounted and man-portable applications. A shipboard version of ACADA that addresses unique shipboard interferents is being built to provide the Navy with an interim monitoring capability until JCAD is fielded. JCAD provides point chemical vapor detection and is in Phase II (Engineering and Manufacturing Development, EMD) of the acquisition cycle. JCAD will function as a chemical point detection system in order to accomplish a variety of mission requirements on multiple service platforms. It will be considerably smaller and lighter than the ACADA and can be configured for a variety of applications, such as individual soldier detectors, shipboard chemical agent monitoring, special operations forces (SOF) applications, and aircraft interior detection JSLSCAD provides passive standoff, on-the-move detection of chemical agent vapor and is in Phase II (EMD) of the acquisition cycle. The JSLSCAD program is a joint program with a JORD being approved by all Services. The basic JSLSCAD system (detector, scanner and electronics module) will weigh less than 50 pounds and occupy approximately one cubic foot. The system may be modified to accommodate a variety of requirements, including the addition of a 360° x 60° scanner for Armored Systems Modernization applications (tracked and wheeled vehicles), and a gimbal mount for Marine Corps helicopters and unmanned aerial vehicle (UAV) contamination avoidance roles. The Air Force's primary use for this system will be in air base defense. The Navy will install JSLSCAD on shipboard and airborne platforms and at high priority oversea installations. This system will be fully evaluated by all the Services during EMD.

In the near-term, the Army, Air Force, and Marine Corps have agreed to focus on the development of a Joint Service Light NBC Reconnaissance System (JSLNBCRS). The proposed system will consist of a suite of detectors required for a specific mission that could be easily integrated into the platform of choice. Currently two configurations are proposed: a light and a medium version, to fulfill expeditionary and armored mission profiles, respectively. The FOX NBCRS would fulfill heavy requirements. The FOX NBCRS is being upgraded to include a chemical standoff detection capability and other electronic improvements including data fusion.

In the far-term, the Army, Air Force, and Marines have agreed to a Joint Chemical Biological Agent Water Monitor (JCBAWM). JCBAWM is a system that will detect the presence of contaminants in potable water. A requirement for an agent water monitor has been identified by the Army, Air Force, and Marines—a tech base program is underway. The operational scenarios defined in the JCBAWM Operational Requirements Document (ORD) include source water, water distributions systems, and verification of water treatment. The Army and Air Force have identified a need for a warning and identification detector. The Joint Service Warning and Identification LIDAR Detector (JSWILD) is a technology base effort to address this problem. JSWILD is a laser-based standoff detection system being developed to meet the need for the detection of chemical liquids, aerosols, and vapors. Although this system is much heavier than its passive counterpart (JSLSCAD), it provides the ability to detect chemical agents in all forms—liquids, vapors, aerosols—as well as mapping and ranging information. In addition, JSWILD will provide similar but shorter range (1–5 km) capabilities in biological standoff detection as those developed and fielded for the Long Range Biological Standoff Detection System.

Biological Warfare Agent Contamination Avoidance. Currently, there are nine biological detection efforts being managed under the Joint Program Office for Biological Defense (JPO-BD):

(1) Interim Biological Agent Detector (IBAD);
(2) Joint Biological Point Detection System (JBPDS);
(3) Biological Integrated Detection System (BIDS);
(4) Long Range Biological Stand-off Detection System (LR-BSDS);
(5) Air Base/Port Biological Detection (Portal Shield) Advanced Concept Technology Demonstration (ACTD);
(6) Portal Shield Production;
(7) Joint Biological Remote Early Warning System (JBREWS) ACTD;
(8) Critical Reagents Program;
(9) Technology Transfer Program.

Currently fielded systems include the Navy's shipboard detection system (IBAD) and the Army's land-based system (BIDS-NDI). The Army's LR-BSDS is a helicopter mounted infrared LIDAR system for the detection, ranging and tracking of aerosol clouds that may indicate a biological warfare (BW) attack.

In the near-term, the Air Base/Port Biological Detection (Portal Shield) ACTD has developed and demonstrated the capability of networked sensors to protect high value fixed sites against BW attacks. Portal Shield has transitioned into production to meet urgent Joint Chiefs of Staff (JCS) directed buy. JBPDS will be produced to meet each of the four Services' needs for an integrated biological point detector. This program is developing a standard bio detection suite that will be integrated on Service designated platforms. Fielding of the BIDS P3I to the 7th CML CO began in 1QFY99 and will be completed by 4QFY99. In addition, the Critical Reagents Program consolidates all DoD antibody, antigen and gene probe/primer developments and requirements. This program will ensure the quality and availability of reagents that are critical to successful development, test, and operation of biological warfare detection systems and medical biological products. The Technology Transfer program will ensure the successful and rapid transition of DARPA and other Service breakthrough biological detection technologies into DoD fielded systems.

In the mid-term, the JPO-BD will demonstrate the Joint Biological Remote Early Warning Advanced Concept Technology Demonstration (ACTD). This tactical distributed network system of lightweight, automated sensors will use fusion to reduce false alarms. The ACTD demonstration test in FY00 will demonstrate enhanced capabilities in detection, identification, and advanced warning of BW attacks.

In the far-term, the concept for the ultimate, joint service chemical and biological detector is the Joint Chemical Biological Universal Detector (JCBUD). JCBUD is envisioned to be a miniaturized, multi-technology, automatic system that may be manned or unmanned, capable of detecting all CW/BW agents, and able to automatically warn troops and report pertinent data relative to a CW/BW attack.

2.3.4 Warning and Reporting

Warning and reporting is a critical capability in contamination avoidance. The Services have agreed to expedite development of this capability by integrating ongoing hardware and software into a Joint Warning and Reporting Network (JWARN). This network will be compatible with, but not duplicate, all C^4I equipment both current and developmental. The JWARN Phase I effort began fielding the first version of software in FY98. The JWARN Phase II effort will be initiated in FY99 into EMD for hardware and software integration onto Service designated platforms and installation at fixed sites.

2.3.5 Other Contamination Avoidance Programs

Various detection and warning requirements have unique mission profiles and technical specifications. While in some instances the development effort may leverage the technical achievements of a closely related detection and warning project, the application beyond its intended mission is limited and accordingly supports a specific requirement. The Navy awarded a production contract in FY97 for the Improved (chemical agent) Point Detection System (IPDS), and will begin installation in FY99. IPDS will be used to automatically detect and alarm in the presence of chemical agents in vapor form and will provide continuous detection and alarm capability in the harsh shipboard environment. The IPDS replaces the existing shipboard Chemical Agent Point Detection System (CAPDS) improving detection thresholds, response time, immunity to shipboard interferents, and adding the capability to detect mustard agents. The Navy is also planning on fielding the Shipboard Automatic Liquid Agent Detector (SALAD) in fiscal year 2000. This shipboard system will be used to automatically detect and alarm in the presence of liquid chemical agents. By detecting automatically, it will minimize the sailor's exposure to contamination. As with the IPDS, it will provide continuous detection and alarm capability in the harsh shipboard environment. A performance-based contract for the low rate initial production of SALAD will be awarded in FY99.

2.3.6 Defense Advanced Research Projects Agency (DARPA) Programs

There are two related BW sensor programs currently ongoing within DARPA: the BW defense environmental sensors programs and the tissue-based biosensors program.

DARPA BW Defense Environmental Sensors Program. DARPA is developing technologies that will enable a multiplexing capability for bioagent identification. Technologies using up-converting phosphors provide improved detection sensitivity, and enhanced multiplexing is being developed that can reveal BW agent family, genus, and species on a single chip. A mass spectrometer is being miniaturized and ruggedized for battlefield use in identifying BW agents and contaminants without the use of liquids. These systems will be automated for unattended operations. Detection technologies that provide information on BW agent pathogenicity and viability are also being developed under the DARPA biological detection program.

DARPA Tissue-Based Biosensors Program. DARPA is exploring the use of biological cells and tissues as detector components for sensor devices that will report on chemical and biological toxins. Cells and tissues can be used to report on the functional consequences of exposure (mechanism and activity) to a wide spectrum of chemical and or biological toxins, whether they are living or dead, or whether they have been bioengineered and are currently undetectable by other means (antibodies, nucleic acid sequencing). Technical issues that are being addressed in the program include, (1) the fabrication of biocompatible matrices and interfaces for the long-term retention of cell and tissue function, (2) pattern recognition from critical pathways responsible for the processing of toxins, (3) sampling strategies to accurately extract and present the toxin from air, liquid, or solid samples, and (4) systems integration into a functional device. The current focus of the program is on the use of neuronal and immunological cells and tissues as detectors for such devices. Engineering of cells and tissues of these origins, including stem cells, is proceeding in order to optimize sensor performance requirements and fabricate prototype devices for testing and evaluation.

2.4 PROTECTION

When early warning is not possible or units are required to occupy or traverse contaminated environments, protection provides life sustainment and continued operational capability in the NBC contaminated environment. The two types of non-medical protection are individual and collective.

- ***Individual protective equipment*** includes protective masks and clothing. Protective masks that reduce respiratory stress on the user while improving compatibility with weapon sighting systems and reduce weight and cost are being developed. Technology advances are being pursued to produce mask systems that provide fully compatible vision capabilities, laser/ballistic protection, and further reduction in logistics and physiological burden. Protective clothing is being developed that will reduce the physiological burden, have extended durability and have less weight and heat stress burden than present equipment.

- ***Collective protection equipment*** consists of generic NBC protective filters and air movement devices that provide filtered air to a wide range of applications, transportable shelter systems equipped with NBC filtration systems and, in selected cases, environmental control. Collective protection, *i.e.*, overpressure, can be applied to mobile and fixed command posts, medical facilities, rest and relief shelters, buildings/fixed sites, vehicles, aircraft, and ships. Lightweight shelters integrated with NBC filtration, environmental control and power generation facilities for medical treatment facilities have been developed and are in production. Technology improvements are being pursued to reduce power requirements and improve filtration capacity against current and future NBC agents. Technologies that reduce weight, volume, cost, and improve the deployability of shelters and filtration systems are also being pursued.

2.4.1 Protection Science and Technology Efforts

2.4.1.1 Individual Protection Goals and Timeframes. The goal of the individual protection area is to reduce the physiological burden associated with wearing protective equipment while maintaining, and potentially improving, the already high level of protection against CB warfare agents and radiological particles (see Table 2-5). To achieve these goals, key physiological performance requirements to the design and evaluation of clothing and respirators are being established. New barrier and filtration materials and selectively permeable materials are being developed and evaluated to accommodate these performance requirements.

2.4.1.2 Collective Protection (CP) Goals and Timeframes. The goals of the collective protection area are to (1) reduce the weight, size and power requirements of CP systems, (2) reduce the logistical burdens associated with the maintenance of CP filters, (3) improve protection capabilities against current and emerging threat agents and (4) improve the deployability of transportable shelter systems (see Table 2-5). To achieve these goals, improvements to system (including transportable shelters) components are being investigated along with improvements to the current vapor and particulate filtration media. Regenerative vapor and particulate filtration materials processes are being investigated to eliminate the need for filter change and improve the capability against any battlespace NBC threats.

Table 2-5. Protection Science and Technology Strategy

By 1999	By 2005	By 2009
• Prototype mask with 50% reduced breathing resistance and 50% improved field of vision • Joint Service Lightweight Integrated Suit Technology (Overgarment and MULO), extended durability, reduced heat stress, increased protection • Demonstrate regenerative filtration pre-prototype for collective protection applications • Complete evaluation of low cost and lightweight CB tentage materials	• Demonstrate advanced adsorbents to enhance or replace carbon • JLIST P3I, Joint Chemical Ensemble, chemical protective garments, gloves and footwear that are lightweight, and have extended durability and reduced heat stress • Demonstrate a duty uniform utilizing selectively permeable membrane technology that provides integrated environmental protection • Demonstrate new collective protection shelters utilizing low cost and lightweight CB tentage materials and novel CB resistant tentage closures	• New transportable shelter system (JTCOPS) • Improvements to collective protection systems (JCPE) • Continuous operation filter technology • Demonstrate lightweight, self-detoxifying clothing

2.4.1.3 Potential Payoffs and Transition Opportunities. Individual protection investments will result in improved respiratory and percutaneous (skin) protection with reduced physiological and psychological burden to the individual warfighter. Improved air filtration systems and/or technologies for collective protection applications will allow for extended operation, in an NBC contaminated environment, reduce the logistics burden associated with filter replacement, reduce weight, volume and power requirements, and improve the capability against current and emerging threats. Filtration technology has commercial application to the chemical industry and automotive applications.

2.4.1.4 Major Technical Challenges. Integrating CB protection into future weapon systems necessitates tradeoffs between performance requirements and limitations of materials and designs. Integral respiratory protection requires tradeoffs between physiological performance parameters such as pulmonary function, field of view, speech intelligibility and anthropometric sizing against cost, size/weight, protection time, and interfacing with other equipment. CB protective clothing development requires balancing the physiological burden imposed upon the warfighter with maximum obtainable CB agent protection. Significant advancements have been made in improving the weight/bulk and power requirements of personal cooling systems, but further work in this area is needed. Air purification systems require tradeoffs with respect to performance, user requirements, size, weight and power constraints, as well as longer life.

2.4.2 Protection Modernization Strategy

Forces cannot always avoid NBC hazards, therefore, individual warfighting units must be provided materiel to protect them from the effects of these lethal agents. Protection must be effective against all known threats with minimal degradation to the performance of personnel, weapons, or equipment. Total NBC protective measures allow our forces to maintain combat superiority in contaminated environments. A summary of protection modernization requirements is provided in Table 2-6. Chemical defense capabilities are routinely demonstrated against actual chemical agents in the Chemical Defense Training Facility (CDTF), U.S. Army Chemical School.

The goal of the protection RDA area is to provide equipment that allows U.S. forces to operate in a NBC contaminated environment with minimal degradation of the warfighters' performance. Near-, mid-, and far-term objectives are to reduce physiological and logistical burdens while maintaining current protection levels. Table 2-7 provides an overview of individual and collective protection RDA efforts and Service involvement.

Protective masks will be improved to provide greater user comfort and to reduce breathing resistance. Mask systems will require increased NBC survivability and compatibility with combat or personal equipment. Future respiratory systems, such as the Joint Service Aviation Mask (JSAM) and Joint Service General Purpose Mask (JSGPM) will require enhanced compatibility with life support equipment, tactical systems, and fixed and rotary wing aircraft. In the future, the focus will be on integrated respiratory protective ensembles which offer optimal compatibility with personal, tactical, and crew support systems.

Future protective clothing ensembles for U.S. forces will require reductions in bulk and weight without any loss of protection or durability. To satisfy these needs, the Services have consolidated their mission specific requirements into a first truly joint program for the next generation chemical garments—the Joint Service Lightweight Integrated Suit Technology (JSLIST) program. The JSLIST program developed and is fielding the JSLIST Overgarment and Multi-purpose Overboots (MULO). The JSLIST Pre-Planned Product Improvement (P3I) will develop improved chemical protective overgarments, duty uniforms, undergarments, gloves, and socks that will increase protection, reduce physiological burden, and have increased durability beyond those items fielded in the baseline JSLIST program. New accessories, such as gloves and footwear, are required to execute missions and tasks which require greater tactility and traction. The Joint Protective Aircrew Ensemble (JPACE) will be developed to provide aviators with the same advantages and improved protection as JSLIST provides to other warfighters. Similarly, clothing systems for Explosive Ordnance Disposal (EOD) personnel and firefighters are required to enhance existing chemical protection systems without undue physiological burdens.

Table 2-6. Protection Modernization Strategy

	NEAR (FY99-00)	MID (FY01-05)	FAR (FY06-15)
Individual Eye/ Respiratory	• **Voice amplification; laser/ballistic eye protection; improved decontamin-ability, better comfort (M40A1/M42A1)** • Army - *Aircrew mask compatible with Apache helicopter systems with a significantly lighter motor/blower unit (M48/M49)* • Army -*Improved compatibility with aviation sighting/night vision systems; reduced logistics burden using non-blower systems, selected for Land Warrior (M45)*	• **Reduced physiological burden, improved comfort, enhanced optical and communications, improved compatibility** • **New mask systems for general purpose and aviation masks (JSGPM, JSAM)** • Navy -*Improved complete protection for all aircrews (CB Respiratory System)*	• **Advanced Integrated Individual Soldier Protection system (Future Soldier System)** • **Improved multiple agent protection**
Individual Clothing	• **Advanced protective suit technology; lighter, improved agent and flame protection; reduced heat stress integrated with all respiratory systems.** **- Improved foot protection (MULO)** • **Improved protection, less burdensome, protective suits; Improved foot and hand protection/less burdensome; Flame protection (JSLIST P3I)** • Army -*Improved protection for short term use for special purposes (ITAP)* • Army -*Improved protection with self contained breathing capability for special purposes (STEPO)*	• **Improved protection (Joint Service Chemical Ensemble)** • **Improved protection for aviators (JPACE)** • **Service Life Indicator and CB duty uniform**	• **Integrated multiple threat modular protection (chemical, biological, environmental, ballistic direct energy and flame)** • **Self-detoxifying clothing**
Collective Protection	• **Chemically Protected Deployable Medical Systems (CP DEPMEDS)** • **Chemically Hardened Air Transportable Hospital (CHATH)** • **Lighter, more mobile, easier setup, more affordable shelters (JTCOPS)** • **Improved current collective protection filters and equipment (JCPE)** • Marine Corps -*Protection for all combat vehicles and unit shelters* • Army -*NBC protection for tactical Medical units (CB Protective Shelter, CBPS).* *- Apply regenerable vapor filter to Comanche,* *- Apply collective protection to advanced vehicle concepts.* *-Modular, reduced size, weight and power for vehicle/ shelter collective protection - Advanced Integrated Collective Protection Shelter (AICPS)* • Air Force - *Upgrade/install collective protection into existing rest/relief shelters.*	• **Improved filters to extend filter life, reduce maintenance and reduce logistical burden** • **Regenerable/advanced protective filtration for vehicles/vans/shelters; reduce logistics burden, improved protection against current and future threats** • **Support medical treatment in a CB environment for Airborne, Air Assault, and Heavy Divisions (CBPS)** • Navy - *Backfit ships with contamination free protected zones - (Selected Area Collective Protection System, SACPS), Integrate collective protection system into V-22*	• **Family of advanced protective filtration systems for vehicles, shelters, ships, and light forces**

1. Joint Service programs are highlighted in **BOLD**, Service unique efforts are *italicized.*
2. Where applicable, systems which meet requirements are listed following the entry.

Table 2-7. Protection RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
	INDIVIDUAL PROTECTION:					
Integrated	- Force XXI Land Warrior	RDTE	Rqmt	Interest	Interest	Interest
Eye/ Respiratory Protective Masks	- MBU-19/P Aircrew Eye/Respiratory Protection (AERP)	Production	Interest	Fielded	Interest	
	- M48/49 Aircraft Mask	Production	Rqmt			
	- CB Respiratory System (A/P22P-14(V))	RDTE			Rqmt	Rqmt
	- M45 Aircrew Protective Mask (ACPM)	Production	Rqmt		Interest	
	- M40A1/M42A1	Fielded	Rqmt		Rqmt	
	- MCU-2A/P	Production		Fielded		Rqmt
	- Joint Service Aviation Mask (JSAM)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	- Joint Service General Purpose Mask (JSGPM)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
Ancillary Equipment	- Protection Assessment Test System (PATS)	Production	Rqmt	Fielding	Fielded	Interest
	- Voice Communication Adapter	Production	Rqmt	Rqmt	Fielded	Fielded
Battlefield Protective Suits	- CB Protective Overgarment Saratoga	Fielded	Interest		Fielded	Interest
	- Chemical Protective Undergarment (CPU)	Fielded	Rqmt		Int-NIR	
	- Joint Service Lightweight Integrated Suit Technology (JSLIST/JSLIST P3I)					
	-- Overgarment	Prod.*	Rqmt	Rqmt	Rqmt	Rqmt
	-- Undergarment (P3I)	RDTE	Interest	Interest	Interest	
	-- Duty Uniform (P3I)	RDTE	Interest	Interest	Rqmt	
	-- Boots (MULO)	MS III*	Rqmt	Rqmt	Rqmt	
	-- Gloves (P3I)	RDTE	Rqmt	Rqmt	Rqmt	
	-- Socks (P3I)	RDTE	Interest	Interest	Interest	
	-Battledress Overgarment (BDO)	Fielded				
Specialty Suits	-Self-Contained Toxic Environment Protective Outfit (STEPO-I) Interim	Fielded	Rqmt			
	- STEPO	MS III	Rqmt			
	- EOD Ensemble	Production	Rqmt			
	- Improved Toxicological Agent Protective (ITAP)	RDTE	Rqmt		Interest	Interest
	- Joint Firefighter Integrated Response Ensemble (JFIRE)	Production	Rqmt	Rqmt		
	COLLECTIVE PROTECTION:					
Tentage and Shelter Systems	- M20A1/M28 Simplified CP Equipment (CPE)	Fielded	Rqmt	Interest		Rqmt
	- CB Protective Shelter (CBPS) (Medical)	Production	Rqmt		Interest	
	- Portable Collective Protection System (PCPS)	Fielded			Rqmt	
	- CP Deployable Medical System–Chemically/ Biologically Hardened Air Transportable Hospital (DEPMEDS/CHATH)	Production	Rqmt	Rqmt		
	- Joint Transportable CP System (JTCOPS)	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
Collective Protection (CP) Systems	- Shipboard Collective Protection System (CPS)	Production	Interest	Interest		Rqmt
	- Shipboard CPE	RDTE	Interest	Interest		Rqmt
	- Modular Collective Protection System (MCPE)	Fielded	Rqmt	Interest		Interest
	- Advanced Integrated Collective Protection System (AICPS) for Vehicle, Vans, and Shelters	RDTE	Rqmt		Interest	
	- Selected Area Collective Protection System (SACPS)	Production			Interest	Rqmt
	- M8A3 GPFU	Fielded	Rqmt			
	- M13A1 GPFU	Fielded	Rqmt	Rqmt		Rqmt
	Joint Collective Protection Equipment (JCPE)		Rqmt		Rqmt	
Generic Filters	- M48/M48A1 (100 cfm)	Fielded	Rqmt		Rqmt	Rqmt
	- M56 (200 cfm)	Fielded	Rqmt	Rqmt	Interest	Rqmt
	- Fixed Installation Filters	Fielded	Rqmt	Rqmt		

Rqmt = Product requirement
Interest = Product Interest
Int-NIR = Product Interest, No Imminent Requirement

* - Sub-Product(s) of a Consolidated Joint Service Project
Rqmt, Interest = Sub-Product requirement or Interest

Collective protection equipment (CPE) development efforts are focused on NBC protection systems at the crew, unit, and platform level. New CPE systems will be smaller, lighter, less costly, and more easily supported logistically. New systems are required to provide clean environments for critical operations (*i.e.*, where individual protective equipment (IPE) otherwise places an unacceptable burden upon the warfighter in performing duties) and for essential rest and relief. Modernization efforts will concentrate on: (1) improvements to current vapor and particulate filtration media to extend filter life and to offer improved performance against current and/or emerging threats, (2) advanced air filtration (vapor and particulate) technologies, integrated with environmental control, to greatly reduce the logistical burden and offer greatly improved performance against current and postulated threats, (3) increased application of collective protection systems onto vehicles, vans, shelters, fixed sites, and ships, within the Joint Services, (4) improved transportable shelter system with integrated power/environmental control/filtration, (5) improvements to current collective protection systems to reduce weight, volume, and power requirements, and (6) standardization of filters within the joint services to address storage and procurement concerns. Efforts are in place to support major weapons systems developments, such as the U.S. Navy V-22 Osprey, the U.S. Army's Comanche, Crusader, Bradley, Breacher, Heavy Assault Bridge, Future Scout and Cavalry System, the USMC Advanced Amphibious Assault Vehicle (AAAV), and other advanced weapons platforms.

2.4.3 Joint Service Protection Programs

Joint programs are shown in Table 2-6 as bolded entries. A detailed description of Joint IPE and CPE programs is provided in Annex B. Section 2.7 provides a response to specific Congressional concerns regarding materials used in the JSLIST program.

Individual Protection

Eye/Respiratory. The M40 and M42 masks (for individuals and armored vehicle crewmen, respectively) are undergoing the final stages of fielding to replace their M17 and M25 series counterparts. The new masks offer increased protection, improved fit and comfort, ease of filter change, better compatibility with weapon sights, and a second skin which is compatible with Army and Marine Corps protective ensembles. The second skin design also is being reviewed by the Navy and Air Force for potential adoption. The Army, Marines, and Air Force are also fielding the Protection Assessment Test Systems (PATS) to provide users of the M40, M42, and MCU-2/P series masks with a rapid and simple means for validating the fit and function of the mask to ensure readiness. The Navy is evaluating the use of PATS with its MCU-2/P series mask.

The Navy, in coordination with the Marine Corps, is leading an effort to equip all forward deployed fixed and rotary wing aircrew with improved chemical, biological, and radiological (CBR) protection. The CBR ensembles will feature off-the-shelf items, such as the CB Respiratory System. The Army, in cooperation with the Marine Corps, recently completed a product improvement program for the M40 series mask that allows ground crew to aircrew communication. The Air Force continues to field Aircrew Eye-Respiratory Protection (AERP) systems to protect aircrews from CB hazards. This system complements the recently fielded lighter weight aircrew ensemble.

Mid- and far-term research is focused on improved vapor and particulate filtration technology, as well as improved masks for light and special operations forces (SOF). Development will be completed in the mid-term for the Joint Service Aviation Mask and Joint Service General Purpose Mask, which will provide improved eye, respiratory, and face protection against current and future agents. It will maximize compatibility with future weapon systems, be lightweight, and offer modular facepieces to accommodate a variety of mission profiles. Protective mask efforts will focus on supporting specific needs of the Joint Services and integrated warrior programs (Land Warrior, Air Warrior, Mounted Warrior, and Force XXI).

Clothing. In the area of full body protection, the JSLIST program coordinated the selection of advanced technology chemical protective materials and prototype materials. The JSLIST Overgarment was adopted by all four services, and the Multipurpose Overboot (MULO) was adopted jointly by the Army, Air Force, and Marines. The JSLIST Overgarment is a 45 day garment that provides 24 hours of chemical protection. It is launderable and lighter weight than the Battle Dress Overgarment (BDO). The MULO will replace the black vinyl overboot/green vinyl overboot (BVO/GVO). The MULO is a 60 day boot that provides 24 hours of chemical protection. The boot has increased traction, improved durability, petroleum, oil, and lubricant (POL) and flame resistance, and better chemical protection than the BVO/GVO.

The JSLIST Pre-Planned Product Improvement (P3I) will address requirements not met through the baseline JSLIST program. This program will obtain new material technologies for overgarments and duty uniforms using the existing JSLIST design. Fabric technologies for a chemical protective undergarment and materials and designs for chemical protective gloves and socks will also be addressed. This program will develop a 60 day overgarment with desired flame resistance (FR), a 30 day overgarment with required FR, a 30 day duty uniform with desired FR, a 7 day overgarment with desired FR, a 7 day undergarment with desired FR, general purpose gloves, high tactile gloves, and socks. Materials that meet Service's requirements will be placed on a qualified materials list to encourage multi-source competition and to provide surge capability. In addition, the Army is working with the Air Force on a chemical protective firefighter's ensemble, leveraging the technology from the JSLIST program.

In the far-term, efforts will focus on integrated protection. Next generation technology will be directed toward integrating CB protection into a system that will also provide environmental, ballistic, directed energy, and flame protection, as well as reduced physiological burden. A strong emphasis on supporting technologies must continue. Materials that detoxify a broad range of chemical and biological agents on contact, which can be incorporated into fibers, fabrics, and selectively permeable membranes are being developed using biotechnology, as well as more conventional approaches.

Collective Protection (CP)

The Army has produced the M20A1 Simplified CPE and the M28 shelter liners to provide CP collective protection to existing structures. Environmental control is also being added to selected applications. The new CPE provides liquid agent resistance and allows expansion of protection area. The M20A1 has been fielded. The M28 Simplified CPE has been integrated into CP DEPMEDS and CHATH field hospitals.

CHATH and CP DEPMEDS are joint programs to integrate environmentally controlled collective protection into already fielded Army and Air Force field hospitals in order to sustain medical operations in a CB contaminated environment for 72 hours. Chemical protection is integrated into existing medical tents and shelters through addition of M28 Simplified CPE, chemically protected heaters, air conditioners, water distribution and latrine systems and alarms. CP DEPMEDS successfully completed an Operational Test 4Q97, with type classification in 4Q99 and fielding in FY00.

The Chemically and Biologically Protected Shelter (CBPS) is a highly mobile, rapidly deployable shelter system designed to be used for Echelon I and II forward area medical treatment facilities. The system is self contained/self-sustaining. It is permanently mounted onto a M1113 Expanded Capacity Vehicle (ECV) with a Lightweight Multipurpose Shelter. The vehicle tows a trailer and generator set. The vehicle transports a CB protected airbeam supported soft shelter, self-contained environmental support and power generation system, a crew of four and gear, and medical equipment. The CBPS presently is in limited production with initial fielding scheduled for 4Q99 to meet an urgency of need requirement. A subsequent Operational Test will be performed in 1QFY00 with full type classification following. A preliminary Operational Test was completed 3QFY98. Mid-term objectives are to initiate development of CBPS to support medical treatment for Airborne, Air Assault and Heavy Divisions.

Other near to mid-term collective protection efforts, such as the Advanced Integrated Collective Protection System (AICPS) will provide a compact, integrated package for power, filtration, and environmental control (heating/cooling). AICPS will provide transportability and maintainability enhancements and decrease system set-up times. Joint Collective Protection Equipment (JCPE) will use the latest technologies in filtration, environmental controls, and power generation to improve and/or standardize current collective protection equipment so that it is lighter, more efficient, more affordable and less logistically burdensome. The Joint Transportable Collective Protection System (JTCOPS) will be the next generation lightweight, modular, easily transportable, self-supporting collective protection shelter that will provide relief from psychological and physiological stresses during sustained operations in a contaminated environment. JCPE and JTCOPS will initiate engineering development in FY00. Redesign and concept tradeoff assistance regarding advanced filtration technologies, such as Pressure Swing Adsorption (PSA) and Catalytic Oxidation (CatOx) has been provided to the Comanche, Crusader, USMC AAAV, and U.S. Army advanced vehicle efforts. The USAF is currently upgrading their collective protective fixed site capabilities.

2.4.4 Other Protection Programs

Program supporting requirements of a single service are shown in Table 2-6 as italicized entries. A detailed description of IPE and CPE projects is presented in Annex B.

Individual Protection

Eye/Respiratory. The Army is developing the M48/49 protective masks to replace the M43 series masks. The M48 will be for Apache pilots and the M49 for general aviator use. They will be lighter and offer enhanced protection and compatibility with night vision and aircrew systems.

In the near-term, the Army will replace the M43 mask for the general aviator with the Aircrew Protective Mask, M45. The M45 is lighter and less expensive than the M43 and features CB protection without the aid of force ventilated air.

Clothing. The Army has approved fielding of the Self-Contained Toxic Environment Protective Outfit (STEPO). STEPO provides OSHA level A protection for Army Chemical Activity/Depot (CA/D), Explosive Ordnance Disposal (EOD), and Technical Escort Unit (TEU) personnel. In the near to mid-term, the Army is developing an Improved Toxicological Agent Protective (ITAP) ensemble for short term operations in Immediately Dangerous to Life and Health (IDLH) toxic chemical environments (up to 1 hr), emergency life saving response, routine Chemical Activity operations, and initial entry and monitoring. The ITAP ensemble will incorporate improvements in material and design. It includes a one-hour supplied air bottle system, which can be switched to a filtered air respirator when operators exit the area of high contamination. A Personal Ice Cooling System (PICS) is being developed for use with both the ITAP and STEPO.

Collective Protection

The Navy now includes the Collective Protection System (CPS) on all new construction ships. Currently the DDG-51, LHD-1, AOE-6, and LSD-41 ship classes are being built with CPS. The Navy also has the capability to backfit CPS on ships already in Service. The Selected Area Collective Protective System (SACPS) has been installed on selected LHA-1 class ships. Air inside the zone is maintained at a higher pressure than the outside air to prevent leakage of contaminants into the protected zone. In the mid-term, the Navy is designing the V-22 Osprey to be the first Naval aircraft to incorporate CBR protection for both aircrew and passengers. The ability to provide a pressurized, contamination free environment is a design requirement. The Navy Shipboard Collective Protection Equipment (CPE) effort will increase the shipboard particulate filter life (from the current one or two years) to at least a three year service life, through the use of new particulate pre-filter materials and the use of new high efficiency particulate (HEPA) filter media. The Shipboard CPE will thus provide millions of dollars of savings in life cycle costs by reducing shipboard maintenance requirements and providing energy efficient fans.

2.5 DECONTAMINATION

When contamination cannot be avoided, personnel and equipment must be decontaminated to reduce or eliminate hazards after NBC weapons employment. Decontamination systems provide a force restoration capability for units that become contaminated. Modular decontamination systems are being developed to provide decontamination units with the capability to tailor their equipment to specific missions. Technology advances in sorbents, coatings, catalysis, and physical removal will reduce logistics burden, manpower requirements, and lost operational capability associated with decontamination operations. The following sections detail CB decontamination science and technology efforts, modernization strategy, and Joint Service programs.

2.5.1 Decontamination Science and Technology Efforts

2.5.1.1 Goals and Timeframes. The goal of decontamination science and technology is to develop technologies that will eliminate toxic materials without performance degradation to the contaminated object and be environmentally safe (see Table 2-8). This area includes decontamination of personnel, individual equipment, tactical combat vehicles, aircraft, facilities, and fixed sites. Decontamination technologies currently being pursued include enzymes, catalysts that improve reactivity, decontaminants that are effective in both fresh and brackish water, and improved reactive sorbents. Supercritical fluid technology and non-ozone depleting fluorocarbons are being investigated for sensitive equipment decontamination, while gaseous ozone is being evaluated as a reactive decontaminant for interior spaces of vehicles such as aircraft. Contamination control involves investigating procedures that minimize the extent of contamination pickup and transfer, and maximize the ability to eliminate the contamination pickup on-the-move as well as during decontamination operations.

Table 2-8. Decontamination Science and Technology Strategy

By 1999	By 2005	By 2009
• Demo improved sorbent delivery systems • Aircraft Interior Decon procedures (non-system, Project DO-49)	• Sensitive Equipment Decon Systems • Demonstrate enzymatic decon • Fixed Site decon systems	• Demonstrate environmentally safe, sensitive equipment decon materials • New self-decontaminating materials • Improved decon material to replace DS 2 • Aircraft and other vehicle interior decontamination

2.5.1.2 Potential Payoffs and Transition Opportunities. The payoff from enhanced decontaminants and decontamination systems will be new non-corrosive, non-toxic, non-flammable, and environmentally safe decontamination systems suitable for a timely elimination of CB agents from all materials and surfaces. This ability will allow the forces to reconstitute personnel and equipment more quickly to increase combat efficiency and lessen the logistic burdens. In the future, reactive coatings may allow the continuation of combat operations without the need to disengage for decontamination. Dual use potential for environmental remediation, especially those dealing with pesticide contamination, is being exploited.

2.5.1.3 Major Technical Challenges. There are two principle technical difficulties associated with this effort. The first is the development of decontaminants that are reactive, non-aqueous, non-corrosive, safe to use on sensitive equipment, decontaminate a broad spectrum of chemical and biological agents, and environmentally safe. The second technical difficulty is the development of decontamination systems that effectively clean all surfaces and materials, while at the same time reduce the manpower and logistics burden. Also, new concepts or technologies for decontamination of fixed sites are needed.

2.5.2 Decontamination Modernization Strategy

Decontamination systems provide a force restoration capability for units that become contaminated. Existing capabilities rely upon the physical application and rinse down of decontaminants on contaminated surfaces. Existing systems are effective against a wide variety of threat agents, yet are slow and labor intensive and present logistical, environmental, material,

and safety burdens. In addition, existing systems are inadequate for electronic equipment decontamination, deficient for large area, port, and airfield decontamination, and rely on DS2 and water. To improve capabilities in this functional area, the Joint Services have placed emphasis upon new decontaminating technologies that reduce existing manpower and logistics requirements. These technologies are safer on the environment, the warfighter, and equipment. Table 2-9 shows the roadmap for modernizing decontamination systems in DoD.

The goal of the NBC decontamination program area is to provide technology that removes and detoxifies contaminated material without damaging combat equipment, personnel, or the environment. The RDA community is working with the Joint Staff and Services' operations community to prepare a roadmap that will integrate RDA efforts with non-RDA efforts. Other effort include policy, doctrine, standards, and revised tactics, techniques & procedures. Research and development of non-corrosive, all-agent multipurpose decontaminants and decontaminating systems for combat equipment, aircraft, and personal gear remains a priority. Alternative technologies, such as sensitive equipment decontamination methods and large scale decontamination systems attract interest across the four Services. Table 2-10 provides an overview of Joint Service RDA efforts and Service involvement.

Table 2-9. Decontamination Modernization Strategy

	NEAR (FY99-00)	MID (FY01-05)	FAR (FY06-15)
Personal Equipment Decontam-inants	• **More reactive, high capacity adsorbent (M291/M295)**	• **Non-caustic, non-corrosive decontaminant for personnel and equipment** • Army-*Higher efficiency decon methods (Sorbent Decon)*	
Bulk Decontam-inants	• **Non-caustic, non-corrosive, easy to store and manufacture multipurpose decontaminants**	• **Decontaminants for fixed facilities** • Army -*Environmentally acceptable replacement for DS-2* • Army -*Enzymes for chemical agent decontamination* • Navy -*Less caustic capability*	• **Mission tailored decontaminants** • Navy -*Contamination resistant shipboard materials*
Expedient Delivery Systems		• **Auto-releasing coatings; reduces skin contact hazard & labor requirements**	• **Self-decontaminating auto releasing coatings; reduces man-power and logistic requirements eliminates skin contact hazard**
Deliberate Delivery Systems	• **High pressure water wash; mechanical scrubber; improved decontaminant dispenser (increased vehicle throughput)** • Army -*High pressure hot water washing and decontaminate scrubber capability; reduced water, labor, and logistic burden (M21/M22 Modular Decon System)*	• **Rapid large scale decon capability for fixed sites; reduced manpower and logistic burden** • **Non-aqueous capability for electronics, avionics and other sensitive equipment** • Air Force - *Sensitive equipment decontamination system for aircraft interiors*	• **Vehicle interior decon capability** • **Supercritical fluid decontamination apparatus** • Army -*Waterless decon capability for electronics and avionics*

1. Joint Service programs are highlighted in **BOLD** while Service unique are *italicized.*
2. Where applicable, systems which meet requirements are listed following the entry.

Table 2-10 Decontamination RDA Efforts

Category	Nomenclature	Status	USA	USAF	USMC	USN
Personnel	- M295 Individual Equipment Decontaminating Kit	Production	Fielded	Fielded	Interest	Interest
	- M291 Skin Decontaminating Kit	Production		Fielded	Fielded	
Combat Equipment, Vehicles, and Aircraft	- M17A2/A3 Lightweight Decontamination System	Production	Fielded	Rqmt	Fielded	Interest
	- M21/M22 Modular Decontamination System (MDS)	RDTE	Rqmt	Int-NIR	Int-NIR	Int-NIR
	- M17 Diesel Lightweight Decontamination System	RDTE		Int-NIR	Rqmt	Interest
	- Sensitive Equipment Decon	RDTE	Rqmt	Rqmt	Rqmt	Rqmt
	- Joint Service Fixed Site Decon	RDTE		Rqmt	Rqmt	
Decontaminant Solutions and Coatings	- Sorbent Decontamination System	RDTE	Rqmt	Interest	Rqmt	Interest
	- Solution Decontaminants					

Rqmt = Product Requirement
Interest = Product Interest
Int-NIR = Product Interest, No Imminent Requirement

* = sub-Product(s) of a Consolidated Joint Service Project
Rqmt, Interest = Sub-Product Requirement or Interest

2.5.3 Joint Service Decontamination Programs

The Army has developed the M291 skin decontamination kit as a replacement for the M258A1 decontamination kit for all Services, and has introduced the M295 for improved personal equipment decontamination. The M295 provides the warfighter a fast and non-caustic decontamination system for personal gear. A new adsorbent which is more reactive and has higher capacity is being developed to improve the performance of the M295 kit.

In the near- and mid- term, DoD continues to research new multi-purpose decontaminants as a replacement for bulk caustic Decontamination Solution 2 (DS2) and corrosive Super Tropical Bleach (STB). New technologies, such as sorbents, enzymatic foams, and reactive decontaminating systems are being explored and may offer operational, logistics, cost, safety, and environmental advantages over current decontaminants. It should be noted that present shipboard chlorine-based decontaminant solutions pose an unacceptable corrosion risk to Naval aircraft. Current procedures require the use of fresh water and normal aircraft detergent solutions.

In the far-term, the Services are seeking non-aqueous decontamination systems to provide for sensitive equipment decontamination at mobile and fixed sites. Additionally, there is interest and research in coatings which can reduce or eliminate the necessity of manual decontamination. A detailed description of the decontamination projects is provided in Annex C.

2.5.4 Other Decontamination Programs

In the near- and mid-term, the Army is developing the Modular Decontamination System (MDS) to enhance vehicle and crew weapon decontamination. The MDS will support thorough decontamination for ground forces and possess mechanical scrubbing and improved decontaminant dispensing capabilities. It will also offer a reduction in size, weight, logistics burden, and workload requirements over existing decontamination systems. Similarly, the Marine Corps has explored an alternative man-portable decontamination system and is in the process of procuring an M17 Lightweight Decontamination System (LDS) with a diesel engine. The Air Force is upgrading existing M17 LDS to M17A2 versions and expanding sorbent kit inventories to improve operational and personnel decontamination programs.

2.6 NON-MEDICAL CB DEFENSE REQUIREMENTS ASSESSMENT

ISSUE: **Advanced technologies and new methods are currently being examined for fixed site decontamination. Follow-up investigations are planned over the next year to determine the requirements necessary to perform decontamination of large areas, including cleaning area to sustain cargo handling operations. Over the past year, the Services have worked together to improve the Joint orientation of NBC defense requirements. The work being accomplished will improve the equipment fielded in the near future. More emphasis needs to be placed on the Warfighting CINCs' requirements as input for equipment research and development. This is necessary to ensure that future equipment meets the needs of the Joint battlespace environment.**

SOLUTION: Areas of concern which are addressed under the management improvement initiatives include the following:

- Identifying baseline capabilities as a measure for determining what tactics, techniques, and procedures may be required.
- Focusing and prioritizing chemical and biological detector programs to ensure that resources are leveraging the most promising technologies and are not diluted by excessive Service unique requirements.
- Developing advanced individual protection ensembles that minimally degrade an individual's performance for all tasks performed in contaminated environments.
- Identifying requirements for collective protection programs to ensure that enough assets are available to complete missions in a CB contaminated environment.
- Developing advanced detection capabilities for the purpose of directing decontamination efforts and monitoring the effectiveness of those efforts.
- Identifying an environmentally safe decontaminant and development of a capability to accomplish fixed site and sensitive equipment decontamination.

ISSUE: **"The conferees understand that the Department of Defense is currently dependent upon a single source of supply for permeable chemical protective garment materials used in the joint service chemical protective suit and related chemical protective garments, and believe that the Department of Defense should consider taking actions necessary to qualify additional sources of supply for these materials. The conferees direct the Secretary of the Army, as executive agent for the chemical-biological defense program, to report to the congressional defense committees on any plans to qualify additional sources for these materials."** (Source: H.R. 1119, Conference Report, National Defense Authorization Act for Fiscal Year 1998 Page 649.)

SOLUTION: The primary goal of the Joint Service Lightweight Integrated Suit Technology (JSLIST) program is to provide the best chemical protective ensemble to the individual Soldier, Sailor, Airman and Marine, leveraging state-of-the-art materials and design through joint service management with close industrial partnership. There can be no compromise in this standard. JSLIST successfully completed a Milestone III decision in April of 1997. JSLIST is presently funded and in production. User requirements are stated in the JSLIST

Joint Operational Requirements Document (JORD). Table 2-11 shows several of the *key* requirements.

Table 2-11. Selected JSLIST Operational Requirements

- Protection against specified levels of liquid agents;
- Protection against specified concentration of agent vapor;
- Protection against specified levels of agent aerosols;
- Protection for specified durations;
- Compatibility with the use of individual and crew-served weapons, all commonly issued protective masks and handwear, footwear and all standard chemical individual equipment in temperate to hot climates at all Mission Oriented Protective Posture (MOPP) levels so that the performance of combat tasks pertinent to mission completion are comparable to the currently approved garment;
- Greater freedom of movement and reduced performance degradation as compared to existing chemical protective garments;
- Not cause significant noise when in a combat environment.

Through comprehensive developmental and operational testing, and an independent assessment, The JSLIST program identified only one material combination that passed all testing. As a result, JSLIST production material is sole source.

The JSLIST Pre-Planned Product Improvement (P3I) program is a follow-on to JSLIST. The program includes participation by all Services and Special Operation Forces. The goal of the JSLIST P3I program is to increase the capabilities of the current chemical protective items. Desired requirements that were not achieved by the JSLIST program will be addressed. The JSLIST P3I program is leveraging industry for improved fabric technologies for use in garments. The existing JSLIST design is used as the baseline, with minimum modifications, as necessary for improvement. In order to address the Services' requirements for socks and gloves, state-of-the-art fabric technologies and designs for socks and gloves have been sought. The goal of the JSLIST P3I program is to initiate a qualification list for chemical protective socks, gloves, and fabrics for garments. The qualification list will be used to procure the items.

The program is being conducted in three phases. In phase I, there are two screening periods: phases Ia and Ib. Fabrics, socks, and gloves submitted by interested firms will be evaluated for minimum characteristics, all of which must be met in order to remain in the evaluation. By using two screening periods, manufacturers are provided an opportunity to participate in the initial screening period and then to improve their fabrics, gloves, and socks that did not meet the minimum criteria, and to resubmit during the second period. In addition, manufacturers that did not submit in screening phase Ia, can submit in phase Ib. Data obtained from both screening periods will be used in the selection process, which will occur after the completion of both screening periods. In phase II, developmental/operational testing (DT/OT) will be conducted to assess the field performance of the selected items. In phase III, technical data packages for the successful candidate fabrics, gloves, and socks will be provided to the procuring agency for insertion in the scheduled JSLIST production buys.

A market survey announcement was published in the Commerce Business Daily on 24 June 1997. An information packet detailing the Users' requirements, test criteria, test

methods, and the overall program schedule was provided to companies responding to the source sought announcement and expressing interest in participating in the program.

Phase Ia is completed. Phase Ib began on 7 May 1998 and was completed in 1QFY99. Phase II will be from 1QFY99-4QFY99. JSLIST P3I is scheduled for a Milestone III review in late 1999 or early 2000. The program goal remains the same, provide the best protection ensemble to our warfighters. The program may identify additional materials to accomplish this end. The program recognizes the importance of multi-sourcing and the business impacts on JSLIST ensemble production. Achieving additional material sources via the JSLIST P3I effort is a goal, though achieving the best protection as established by the JORD is the primary goal.